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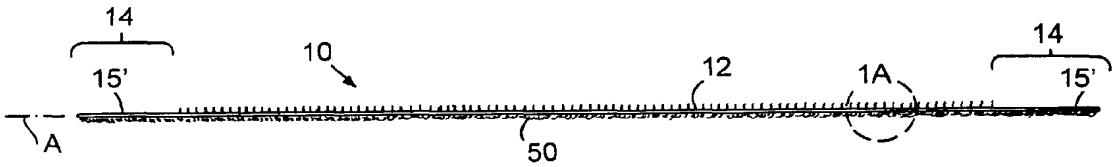
(54) Title: RELEASABLE STRAP



(57) Abstract: A releasable strap (10) of hook and loop material is formed by continuously introducing molten resin (44) to a gap (42) defined adjacent a rotating mold roll (22) having an array of fastener element cavities (20), to form a band of hooks (12) extending from one side of a strip-form base (15). The resin also extends over an edge region (46) of the mold roll devoid of fastener element cavities, extending along one side of the molding region (45) of the mold roll, to form an edge portion (15') of the strip-form base devoid of fastener elements. A loop material (50) is bonded to an opposite side of the strip-form base (15), such as by introducing the loop material to the resin in the gap (42), and the resulting product is cut across both the band of fastener elements and the edge portion (15') of the strip-form base, to form straps (10) having end portions devoid of fastener elements (12).

WO 02/25789 A2

RELEASABLE STRAP

TECHNICAL FIELD

This invention relates to releasable straps, such as those employed for the temporary tying together of loose components.

BACKGROUND

One use of a releasable strap is the temporary tying together of loose components of an automobile wiring harness after manufacture, for delivery from the manufacturer to a remote automotive assembly plant. At the assembly plant the strap is removed by an assembly line worker as the wiring harness is installed.

A desirable strap for such temporary bundling of wiring harnesses and other materials is a so-called hook and loop strap, which has a field of loop-engageable hooks extending along one side of the strap and a field of hook-engageable loops on the other side. Typically the entire surface of the sides of the strap comprise hook and loop materials, respectively. The hook and loop materials are designed to be aggressive to assure that the wiring harness bundle or other materials remain undisturbed during handling.

The complementary fastener hooks and loops permit releasable hook-and-loop fastening when the strap is wrapped e.g., about the wire harness and over itself so that a region of hooks on the inside surface of the strap engage with loops on the strap's outside surface. A worker in an automotive assembly line can then grasp the end of the aggressive strap and peel the engaged strap portions apart to release the wiring assembly. Because the worker typically wears gloves, it has been common to apply a masking material to the end of the strap on the hook-side to provide a plain end to the strap, i.e., an end that has no hooks available to engage the loops. This end portion then stays free of the loops and provides a portion to be grasped and pulled to peel the fastener components apart to, release the strap.

Typically, such strap products have been formed by applying continuous lengths of loop material to continuous lengths of hook material. The continuous laminated material has then been cut longitudinally (in the machine direction) into

continuous strips of suitable width. These strips have then been cut to the desired length. An excellent way of forming the base hook and loop material has been by the process shown in Kennedy et al. U.S. 5,260,015, in which, during molding of the hooks on a rotary mold, a pre-formed loop fabric is laminated to the side of the base layer opposite that from which the hooks extend, while the hook material is on the mold roll, so-called "in situ" lamination.

SUMMARY

According to one aspect of the invention, a method is provided of forming a releasable strap of hook and loop material, the strap having a hook side and a loop side, the hooks being formed of synthetic resin on a mold roll that has a multiplicity of hook mold cavities. According to this aspect of the invention, the mold roll has at least one relatively wide-hook molding region, and has, at least at one side of the hook-molding region, a relatively narrow region devoid of hooks. Using this machine, a continuous sheet material is produced having, in the machine direction, on one side a wide band of loop-engageable hooks and an adjacent relatively narrow band devoid of the hooks, while hook-engageable loops are on the opposite side of the material. The method further involves repeatedly cutting the continuous material at a substantial angle to the machine direction, the cuts extending across the wide and narrow bands to define a series of straps of constant pre-selected length, each strap being characterized by having fastener loops on one side and on the other side a main length portion covered with fastener hooks and at least one end portion devoid of hooks.

The invention also features a method of forming a releasable strap of hook and loop material, the strap having a hook side and a loop side, the hooks being formed of synthetic resin on a mold roll defining a multiplicity of hook mold cavities, the method comprising providing a mold roll having at least one relatively wide hook molding region over which hook mold cavities are distributed and, at least at one side thereof, a relatively narrow region devoid of hooks, and exposing both regions to plastic resin and utilizing the mold roll to form a continuous sheet of material having on one side a wide band of loop-engageable hooks and an adjacent relatively narrow band of resin devoid of hooks, while hook-engageable loops are on the opposite side

of the material, and repeatedly cutting the material at a substantial angle to the machine direction, the cuts extending across the wide and narrow bands, to define a series of straps of constant pre-selected length having hook-engageable loops on one side and, on the other side, a main length portion covered with hooks and at least one end portion that is devoid of hooks and stiffened by resin.

In another aspect of the invention, the above methods are performed omitting the portion of the mold roll devoid of hooks, to produce straps by cross-wise or angled cuts.

Some preferred embodiments of the invention have one or more of the following features.

On the mold roll there are relatively narrow regions devoid of hooks on both sides of the relatively wide hook mold region, and the method provides straps having on the hook side, end portions at both ends of the strap that are devoid of hooks, and which, in many instances, are preferably stiffened by the resin.

Preferably, for use for instance in securing automotive harnesses, the end portions devoid of hooks are sized to enable grasping by a gloved worker to exert pull on the strap to peel the hooks from their engagement with the loops that they overlap.

Advantageously, a rotary cutter can be employed having parallel cutting elements that are spaced apart by the desired width of the straps, to form cuts or perforations in the continuous length of material.

In one preferred case, the elements of the rotary cutter are helically arranged to make the cuts or perforations in lines at a substantial acute angle to the machine direction, and the resulting straps taper to points at their ends. In another case the cuts or perforations are made in lines at a right angle to the machine direction, resulting in straps having square ends.

Advantageously, the methods are conducted in such manner that the cutting is controlled to partially sever or partially perforate the straps to form lines of substantial weakening, but leaving the straps connected sufficiently to enable the overall material to be rolled into the form of a supply roll from which individual straps or groups of straps can be detached by breaking away at selected lines of weakening. In one preferred embodiment, the straps are approximately 19 inches (48 centimeters) in

length. Portions having plain surfaces are preferably approximately one inch (25 millimeters) in length each.

Preferably, the strap material is formed by employing an extruder that introduces molten resin to the molding roll and the loop material is applied either simultaneously or immediately following the formation of a continuous hook strip, while the hook resin remains on the roll. Preferably methods as shown in Kennedy et al., U.S. 5,260, 015 or its variation, Murasaki et al., U.S. 5,441,687, are employed for in situ lamination of the loop material. These references are hereby incorporated by reference.

In one case the mold roll is utilized by forming a nip between the mold roll and a pressure roll, and introducing, to the nip, a sheet of molten resin from an extruder, while, preferably, preformed continuous sheet material defining the loops is introduced into the nip along with the resin in the manner that the sheet material is laminated in situ to a base layer of the resin while hooks are formed integrally by the mold roll on the other side of the resin.

In another case, a nozzle is shaped to define a mold region at a portion of the periphery of the mold roll and resin is introduced via the nozzle to the mold region from an extruder, while, preferably, preformed continuous sheet material defining the loops is introduced to the resin following the nozzle while the resin remains in the roll in the manner that it is laminated in situ to a base layer of the resin, the hooks on the other side of the material remaining in their mold cavities during this in situ lamination.

The mold roll comprises a series of mold-defining disks stacked together to define circumferentially arranged rows of hook molds.

Regions of the mold roll devoid of hooks are each defined by at least one cylindrical section having a smooth periphery.

The region of the mold roll devoid of hooks is defined by a set of disks having smooth peripheral surfaces, which are stacked together to effectively define the cylindrical section.

In another aspect, the invention comprises a releasable elongated strap of hook and loop material, the strap having an axis of elongation, the strap having a hook side and a loop side, the hooks being formed of synthetic resin, the hooks being formed in

rows extending in a given direction (termed the machine direction) on the strap, the given direction of the rows of hooks extending at a substantial angle to the axis of elongation of the strap, the straps having hook-engageable loops on one side and, on the other side, a main length portion covered with hooks and preferably at least one, preferably resin-stiffened, end portion devoid of hooks.

Preferred embodiments of this aspect of the invention have one or more of the following features.

The elongated strap has both end portions devoid of hooks.

The elongated strap has, on its hook side, a region devoid of hooks defined by synthetic resin having a molded matte surface suitable for receiving hand writing as by pen, crayon or marker.

The end portion or portions of the strap devoid of hooks are sized to enable grasping by a gloved worker to pull the strap, to peel the hooks from engagement with the loops.

The given machine direction lies diagonally, at a substantial acute angle to the direction of elongation of the strap and the end portions of the strap taper to points.

The given direction lies perpendicular to the direction of elongation of the strap and the end portions of the strap are square.

A multiplicity of straps are defined by partial cuts or perforations of a sheet of the material, remaining portions maintaining the integrity of the sheet while enabling a user to readily tear a strap from the remaining sheet, preferably a supply roll being defined by the joined straps.

According to another aspect of the invention, a method of forming a releasable strap fastener product having an array of fastener elements on one side and engageable loops on an opposite side, includes continuously introducing molten resin to a gap defined adjacent the periphery of a rotating mold roll, in a machine direction, such that the resin forms a strip-form base at the periphery of the mold roll and fills an array of fastener element cavities defined in a molding region of the rotating mold roll to form a band of fastener elements extending from one side of the strip-form base. The resin also extends over an edge region of the mold roll devoid of fastener element cavities, and along one side of the molding region and of a width less than that of the molding region, to form an edge portion of the strip-form base devoid of fastener

elements. A loop material is bonded to an opposite side of the strip-form base to form loops for engagement by the band of fastener elements, to form a laminate fastener product. The laminate fastener product is repeatedly cut at a substantial angle to the machine direction, across both the band of fastener elements and the edge portion of the strip-form base, to define a series of straps having engageable loops on one side and, on an opposite side, a main length portion covered with fastener elements and an end portion devoid of fastener elements.

According to yet another aspect, a releasable elongated strap of hook and loop material has engageable loops on one side and, on an opposite side, a main length portion covered with fastener elements extending integrally from a strip-form base of resin that extends to cover an end portion of the strap devoid of fastener elements.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIG. 1 is a side view of an embodiment of the product of the invention, while Fig. 1A is a greatly enlarged portion of Fig. 1 and Fig. 1B is a view taken on line 1B-1B of Fig. 1A;

FIGS. 2 and 3 are plan views of two different straps produced according to the invention;

FIG. 3 is a side view of a mold roll used in a preferred embodiment of the method of the invention;

FIGS. 4 and 5 are side views of two embodiments of machines for making straps of the invention which FIG. 4A is a magnified view of a designated portion of FIG. 4;

FIG. 6 is a plan view of portions of the machine of Fig. 4, while FIG. 6A is a plan view of a modification of the machine of Fig. 6;

FIG. 6B is a perspective view of a roll of straps formed with the machine of Fig. 6;

FIG. 7 illustrates cables bundled together by straps according to the invention and FIG. 8 illustrates a worker releasing a strap of Fig. 7.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

FIG. 1 shows a strap 10 having a field of hooks 12 and plain end portions 14 that in this preferred form are resin-stiffened by a continuation 15' of the base layer 15 of the resin from which the hooks 12 extend. The strap has an axis A of elongation. With reference also to the plan view of FIG. 2, it is seen that the strap has pointed resin-stiffened ends and has edges 16 and axis A that lie at an acute angle a to the machine direction M. In FIG. 2A a similar strap is shown having resin-stiffened square ends while edges 16 and axis A lie perpendicular to the machine direction M.

FIG. 3 shows a cylindrical mold roll, rotatable about axis A, which is suitable for forming the straps of FIGS. 1, 2 and 2A, the mold roll surface has a band 45 of major width W that has a distribution of mold cavities 20 (see Fig. 4A) and end regions 46 of the roll surface that are plain and of lesser width E. The roll is formed of a series of disks or mold rings 48 that are stacked together along axis A. In the molding region 45 where it is desired to form hooks, the periphery of mold disks 48 are provided with mold cavities 20, sided on each side with smooth periphery spacer discs that form the sides of the molds. In the regions 46 devoid of hook cavities, the peripheries of the rings may all be smooth, or may define dimples, projections, texture or ridges that facilitate grasping by hand, or provide a matte writing surface for marking.

FIG. 4 illustrates a machine and process for forming the hook portion of the strap of FIGS. 1, 2 and 2A employing roll 22 of FIG. 3. In some cases the hook material is removed from the mold roll and is later laminated on its backside to a loop material. However, preferably, as shown in dotted lines, a pre-formed loop material 50 is introduced to the nip 42 between the mold roll 22 and a pressure roll 62 at the same time as the molten resin 44, according to the process described generally in Kennedy et al., U.S. 5,260,015. In an alternative form, a strap is formed using the mold roll by the variant of the Kennedy technique, which is shown generally in Murasaki et al., U.S. 5,441,687. In each case, in situ lamination occurs under pressure

while the heated resin 44 is on the mold roll 22, taking advantage of the encapsulating and adhesive properties of the resin, and protection of the hooks by their being in their mold cavities 20 at the time of application of lamination pressure.

Preferably, using these in situ techniques, the die of the extruder produces a supply of hook-forming resin that covers both bands 45 (of hook) and band 46 (devoid of hooks), and during the process the resin encapsulates the fibers on the facing side of the loop material over both bands, forming a permanent union by encapsulating or adhering to the fibers. The resin 15' in region 46 is integral with the resin that forms the base layer 15 of the hook portion. The resin layer in region 46 may be finished with a shiny surface or a surface, which has hand-graspable protrusions or texture suitable for grasping or writing, and in either case serves to stiffen the end portion of the strap making it easy to grasp during quick hand actions of an assembly line worker, for instance.

In embodiments in which stiffening of the end portion is not desired, the supply of plastic is limited essentially to the band or bands 45, while the loop fabric being laminated in situ is wider, to cover both bands 45 and 46.

In a preferred embodiment for use with automotive harnesses the loop material is a strong hook-engageable material such as a knit loop nylon material available from Velcro USA, Inc., of Manchester, New Hampshire. The hook material is also strong, employing, e.g., hook style CFM 15 of polyethylene, available from Velcro, USA Inc.

As suggested in Fig. 4, at a later stage the laminated material may be cut at cutter C into individual straps, at cut lines lying at an angle to the machine direction.

As shown in FIG. 5, preferably, following formation, the wide material is rolled into a roll. In a particularly preferred embodiment a rotary cutter C' makes partial angular cuts or perforations across the web while the product is still on the roll stack, before being formed into supply rolls.

According to another embodiment, FIG. 6, a roll of uncut material is subsequently unrolled and passed through a rotary die station 30 in which the material is perforated or partially cut with helical parallel blades 52 or perforating elements along diagonal lines as shown to provide lines of weakening 54 that define the straps, the resultant straps having pointed ends 56 of hook-free material. The material is then re-rolled into a supply roll 40 consisting of the partially severed straps (see also FIG

6B). In a preferred case the diagonal cuts or perforation lines 54 form an angle of about 45° to the machine direction M.

In another embodiment, illustrated in FIG. 6A, at the rotary die station 30', the material is perforated or partially cut with blades or perforating elements 52 that are parallel to the axis of the rotary cutter, along lines perpendicular to the machine direction M. The resultant straps have square ends of hook-free material.

FIG. 7 illustrates the formation of a cable harness employing a strap 10 detached from the supply roll 40 and wrapped around a cable assembly 60 so that an end portion 56 devoid of hooks and an adjacent region having hooks overlaps the back of the strap that carries loops.

FIG. 8 illustrates an automobile assembly worker detaching the strap of FIG. 7 at an assembly plant remote from the location of the original manufacture of the cable harness 60. It is seen that the worker has gloved hands. The plain, resin-stiffened ends 14 of the straps do not adhere to the loop surface of the strap, and stand free, readily available to be grasped by the worker and peeled away with little loss of time. The hand-graspable roughness-providing protrusions or texture suggested by the stripping in FIG. 8 facilitates this action.

A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A method of forming a releasable strap fastener product (10) having an array of fastener elements (12) on one side and engageable loops on an opposite side, the method comprising:

continuously introducing molten resin (44) to a gap (42) defined adjacent the periphery of a rotating mold roll (22), in a machine direction (M), such that the resin forms a strip-form base (15) at the periphery of the mold roll and fills an array of fastener element cavities (20) defined in a molding region (45) of the rotating mold roll to form a band of fastener elements (12) extending from one side of the strip-form base, the resin also extending over an edge region (46) of the mold roll devoid of fastener element cavities, the edge region extending along one side of the molding region and of a width less than that of the molding region, to form an edge portion (15') of the strip-form base devoid of fastener elements;

bonding a loop material (50) to an opposite side of the strip-form base to form loops for engagement by the band of fastener elements (12), to form a laminate fastener product; and then

repeatedly cutting the laminate fastener product at a substantial angle (α,90°) to the machine direction (M), across both the band of fastener elements (12) and the edge portion (15') of the strip-form base (15), to define a series of straps (10) having engageable loops on one side and, on an opposite side, a main length portion covered with fastener elements and an end portion devoid of fastener elements.

2. The method of claim 1 in which the loop material (50) is bonded to the strip-form base (15) by

introducing the loop material to the resin (44) at a point at which the resin forming the base is disposed adjacent the periphery of the mold roll (22) and under conditions selected to cause the material to become permanently bonded to the resin of the base (15);

solidifying the resin; and then

stripping the product from the periphery of the mold roll (22) by pulling the solidified fastener elements (12) from their respective cavities (20).

3. The method of either of claims 1 or 2 in which the edge portion (15') of the strip-form base extends to an end of each strap (10), such that the strap ends (14) are stiffened by resin of the edge portion (15') of the strip-form base (15).

4. The method of any of the above claims in which the fastener element cavities (20) are aligned in circumferential rows on the mold roll (22), resulting in rows of fastener elements (12) on the straps (10) that lie at a substantial angle (α,90°) to a longitudinal axis of extent (A) of the straps (10).

5. The method of any of the above claims in which the resin (44) extends over edge regions (46) of the mold roll (22) devoid of fastener element cavities (20) along both sides of the molding region (45) and of a width less than that of the molding region, to form end portions (14) devoid of fastener elements on both ends of each strap (10).

6. The method of any of the above claims in which the end portion (14) of the strap devoid of fastener elements is sized to enable grasping by hand, to pull the strap (10) to peel the fastener elements (12) from engagement with the loops (see Fig. 8).

7. The method of any of the above claims in which the straps (10) are cut by a rotary cutter (C',30,30') having cutting elements (52) arranged to form cuts or perforations (54) at a substantial angle to the machine direction.

8. The method of claim 7 in which the cutting elements (52) are helically arranged on the rotary cutter (30) to form diagonal cuts or perforations (54) in lines at an acute angle (α) to the machine direction (M), to produce strap end portions (56) that taper to points.

9. The method of claim 7 in which the cutting elements (52) are arranged in lines parallel to the axis of the rotary cutter (30') and at a right angle to the machine direction (M), to produce square strap end portions.

10. The method of any of the above claims in which the cutting is controlled to partially sever or perforate the straps to form lines of weakening (54), leaving adjacent straps (10) connected to each other sufficiently to enable the material to be rolled into the form of a supply roll (40) from which individual straps (10) can be detached by breaking away at selected lines of weakening (54).

11. The method of any of the above claims in which the mold roll (22) comprises a series of mold-defining disks (48) stacked together to define circumferentially arranged rows of hook-shaped molding cavities (20).

12. The method of any of the above claims in which the edge region (46) of the mold roll (22) devoid of hooks is defined by a cylindrical section of the mold roll formed by a set of disks (48) which are stacked together to define said cylindrical section.

13. The method of any of the above claims in which the gap (42) comprises a nip defined between the mold roll (22) and a pressure roll (62).

14. The method of claim 13 in which the loop material (50) is bonded to the strip-form base (15) in the nip as the fastener elements (12) are molded.

15. A releasable elongated strap (10) of hook and loop material, the strap having

engageable loops on one side and, on an opposite side,

a main length portion covered with fastener elements (12) extending integrally from a strip-form base (15) of resin that extends to cover an end portion (14) of the strap (10) devoid of fastener elements (12).

16. The elongated strap of claim 15 in which, on said opposite side, the strip-form base (15) extends to cover two, opposite end portions (14) devoid of fastener elements.

17. The elongated strap of claims 15 or 16 in which the end portion (14) or portions of the strap devoid of fastener elements is or are sized to enable grasping by a gloved worker to pull the strap to peel the fastener elements (12) from engagement with the loops.

18. The elongated strap of any of claims 15-17 in which the fastener elements (12) are arranged in rows extending in a given direction disposed across the strap between longitudinal sides (16) thereof.

19. The elongated strap of claim 18 in which the given direction lies diagonally, at an acute angle (α) to the length of the strap, and in which the end portion (56) of the strap tapers to a point.

20. The elongated strap of claim 18 in which the given direction lies perpendicular to the length of the strap and in which the end portion (14) of the strap is square.

21. A multiplicity of straps according to any of claims 15-20 defined by partial cuts or perforations (54) of a sheet of material, remaining portions maintaining the integrity of the sheet material while enabling a user to readily tear a strap (10) from the remaining sheet material.

22. The multiplicity of straps of claim 21 rolled into a roll 40.

23. The elongated strap of any of claims 15-21 in which the strip-form base of resin (15') in the end portion (14) of the strap has an exposed surface with a surface roughness or projections selected to facilitate grasping.

24. The elongated strap of any of claims 15-21 in which strip-form base of resin (15') in the end portion (14) of the strap has an exposed surface (66) with a surface roughness or projections selected to be written upon.

25. The elongated strap of claim 24 in which the exposed surface (66) has a molded matte surface.

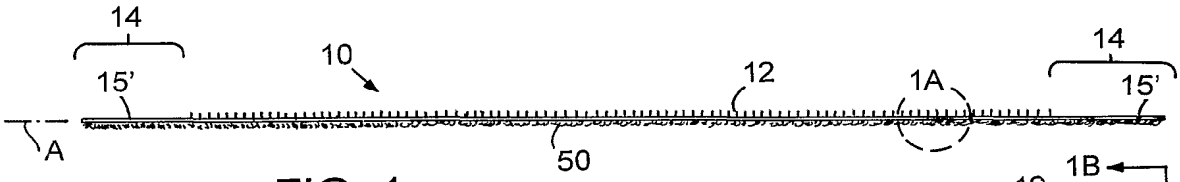


FIG. 1

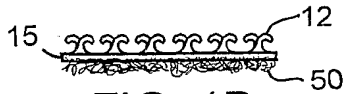


FIG. 1B

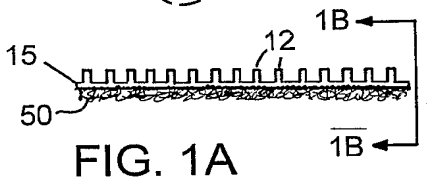


FIG. 1A

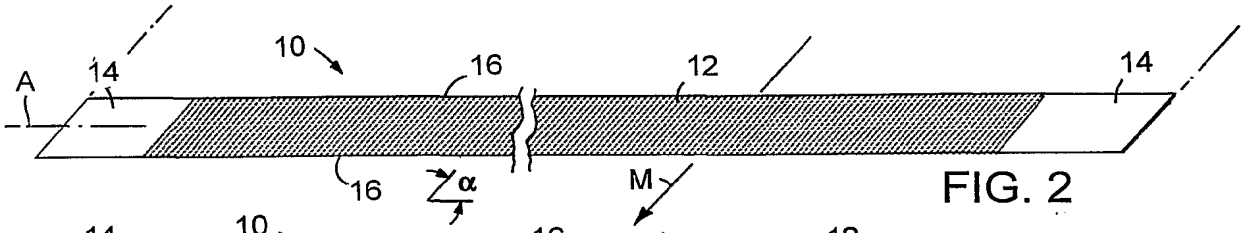


FIG. 2

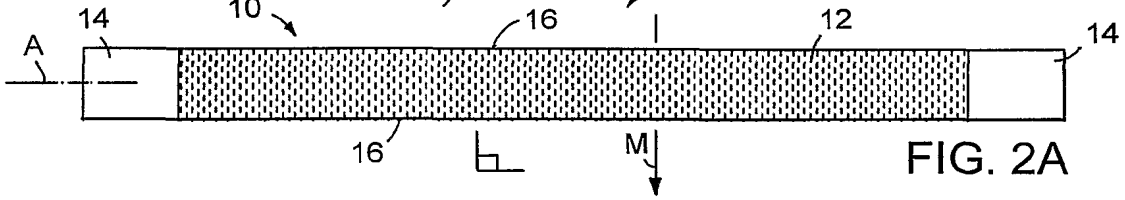


FIG. 2A

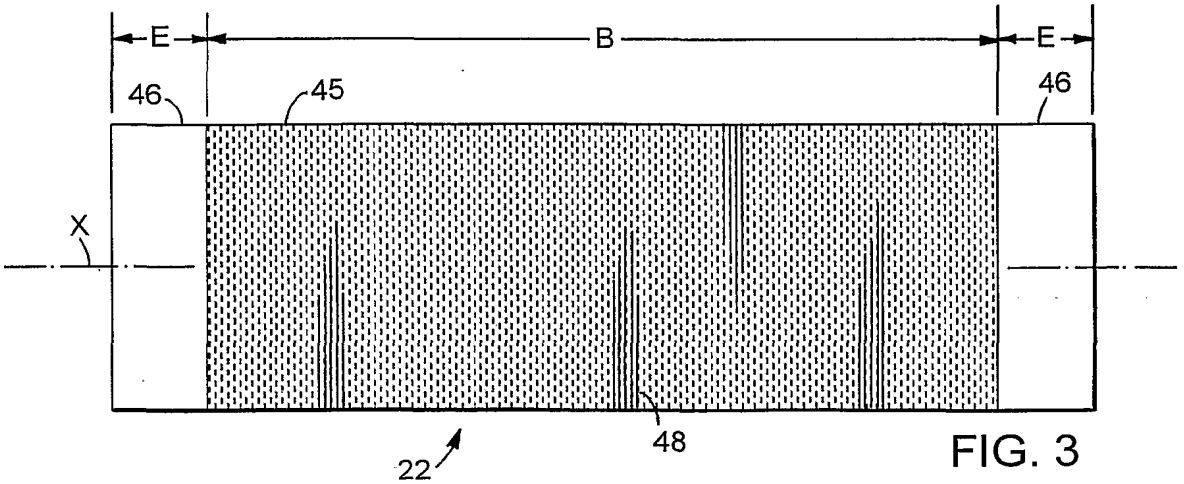


FIG. 3

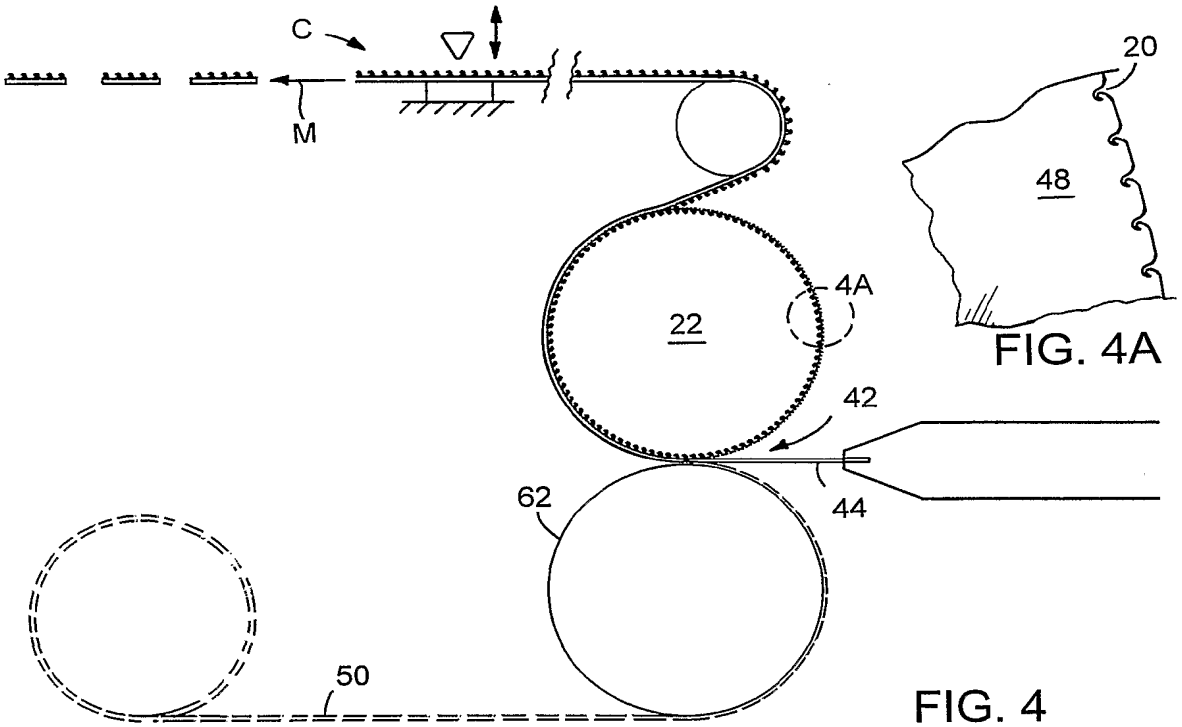


FIG. 4A

FIG. 4

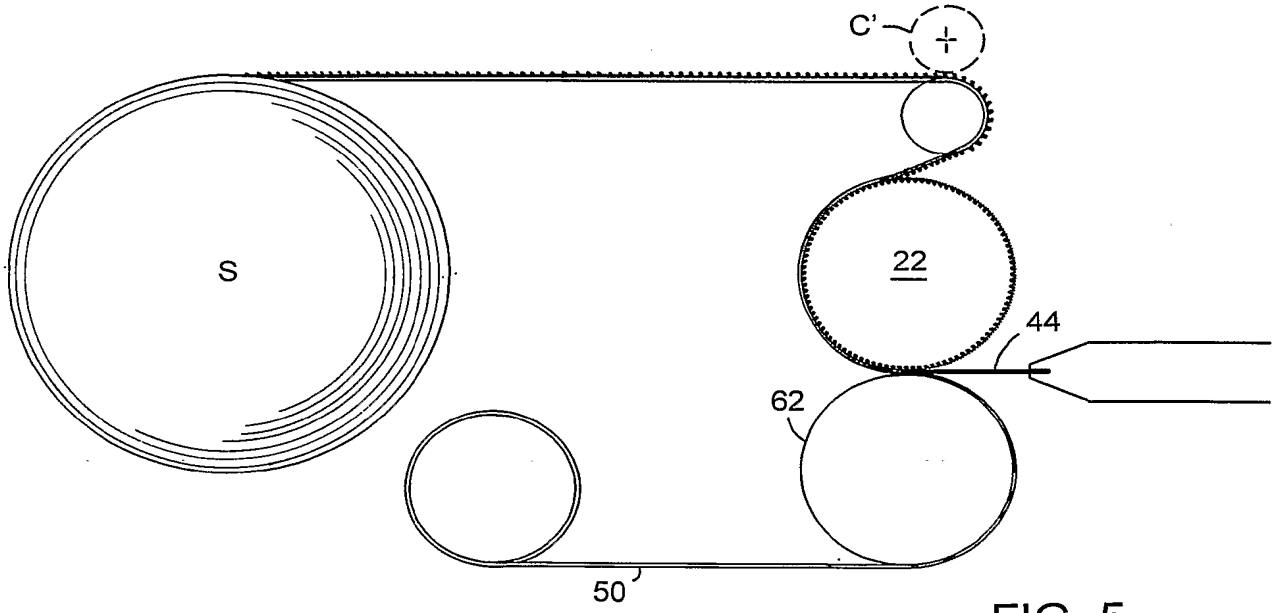
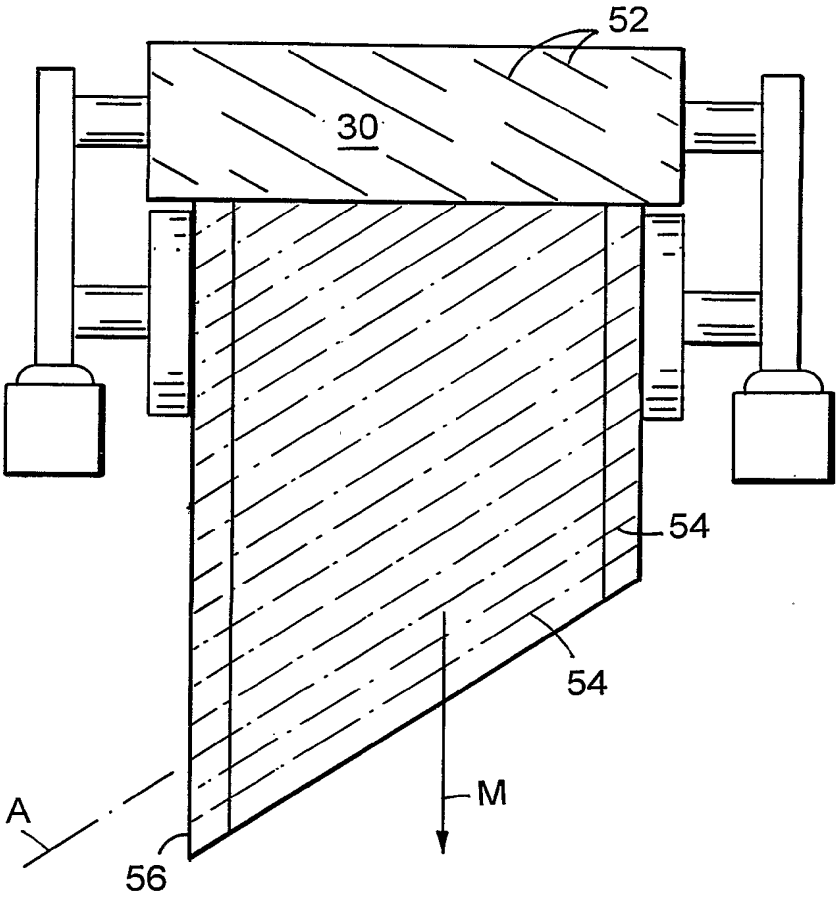


FIG. 5



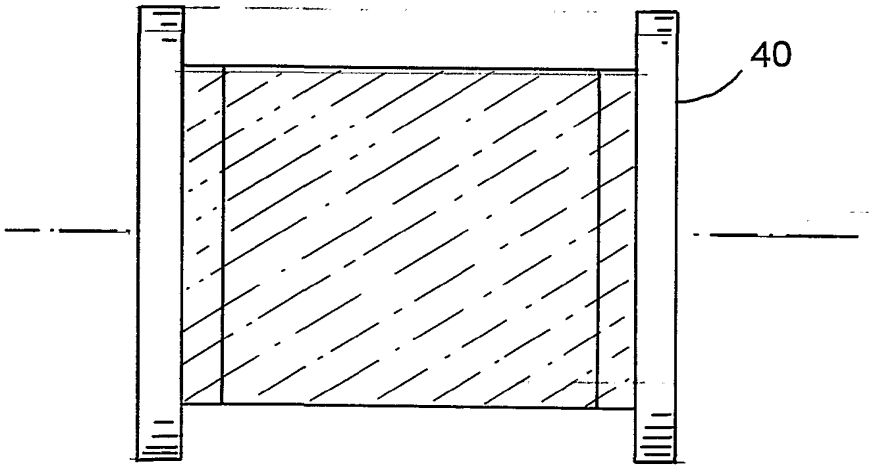


FIG. 6

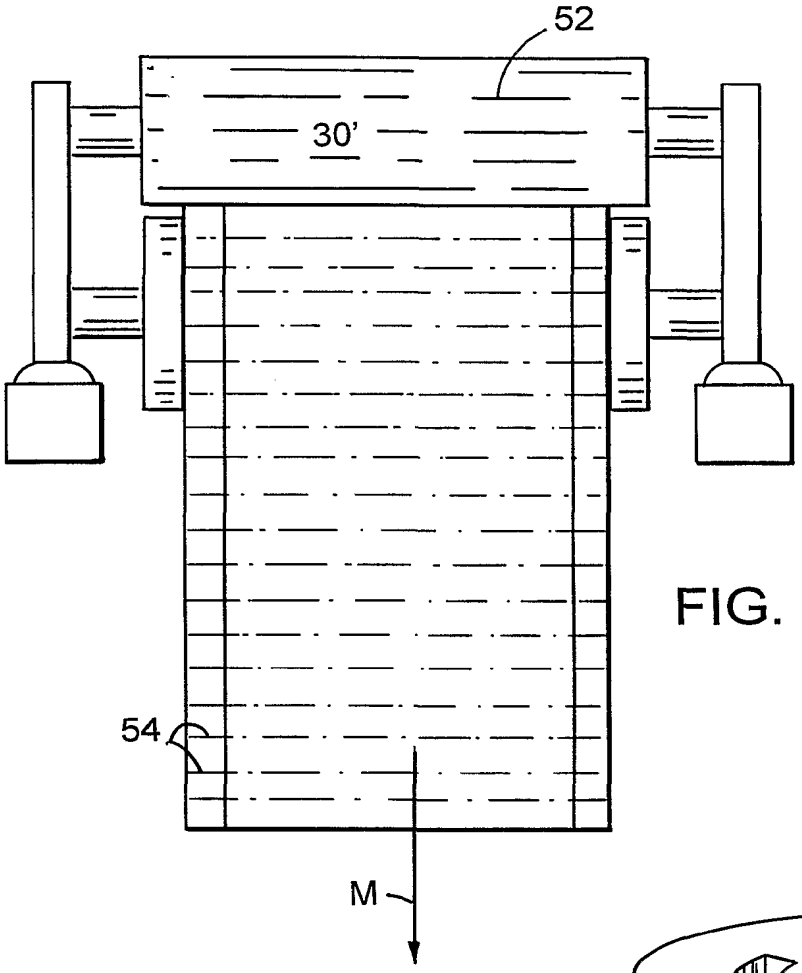


FIG. 6A

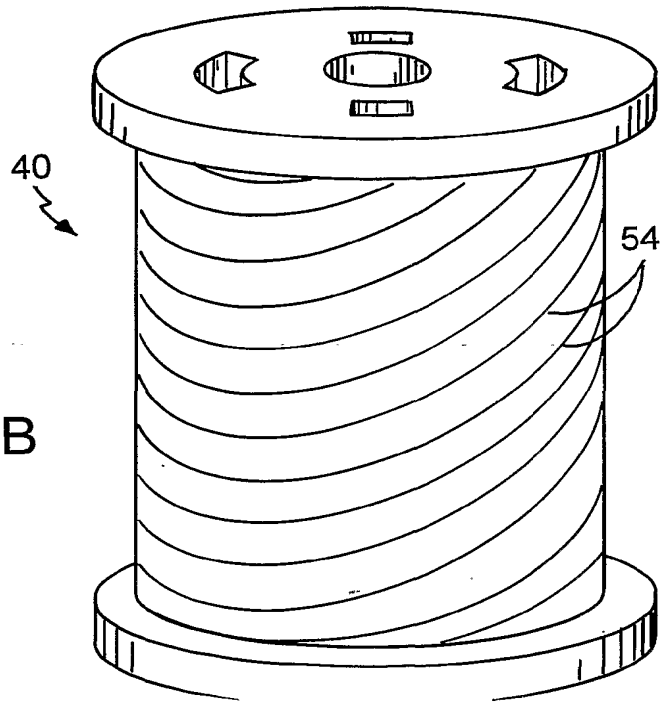


FIG. 6B

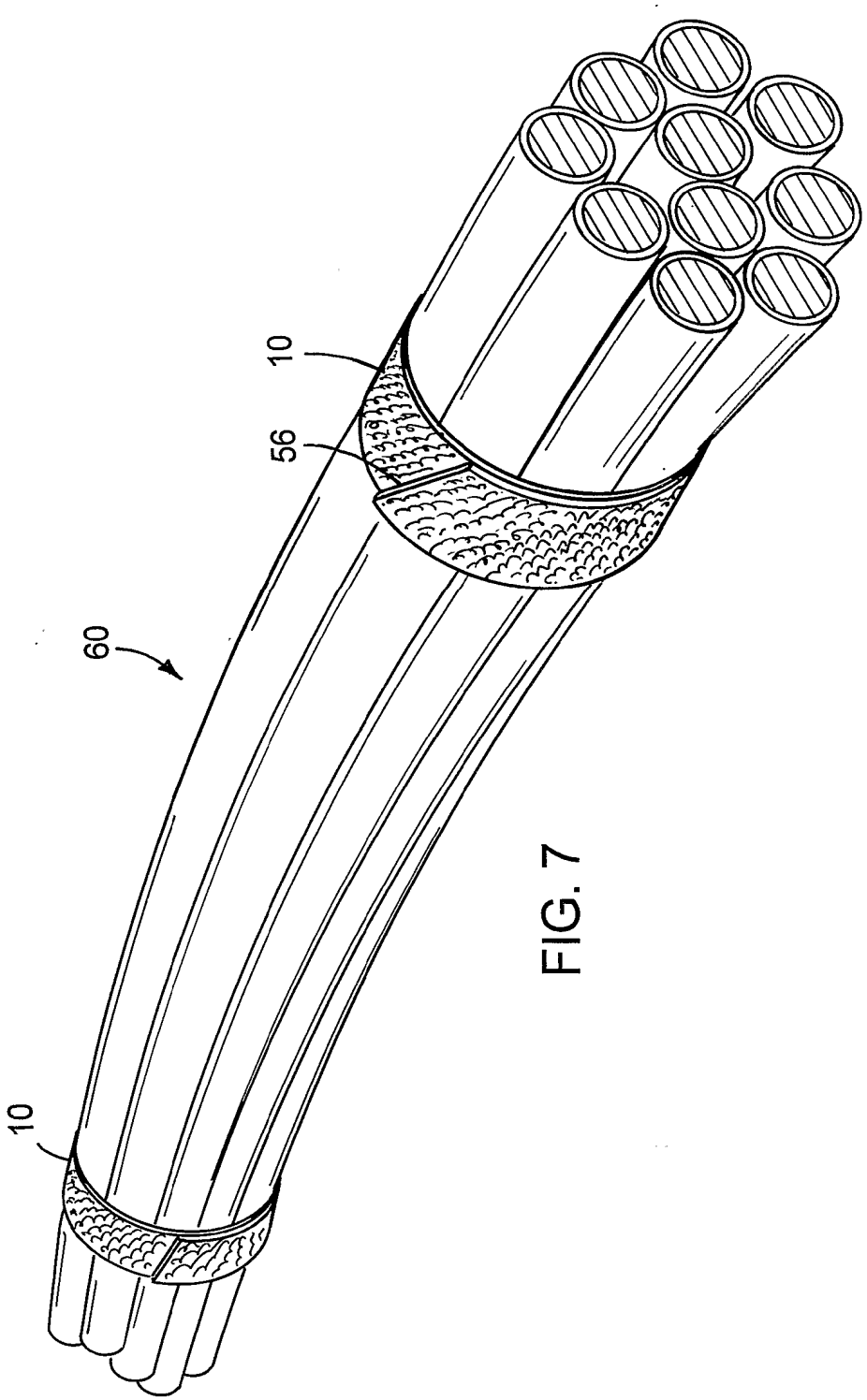


FIG. 7

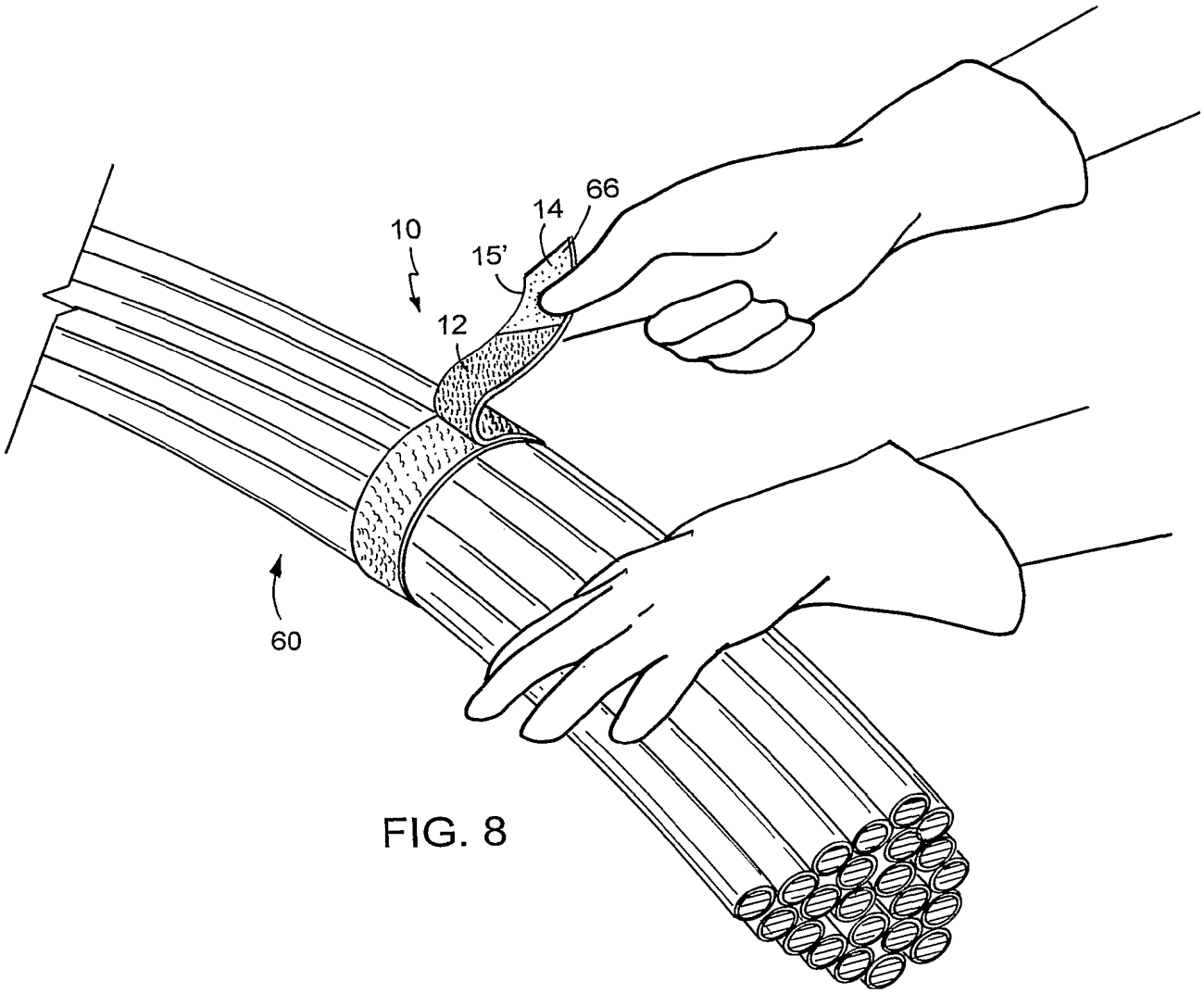


FIG. 8